ICC 2017 WASHINGTON JULY 02-07, 2017

Texture generation for expressive rock drawing

Sidonie Christophe[1], Hugo Loi[2], Mathieu Brédif[1], François Lecordix[1], Thomas Hurtut[3], Romain Vergne[2] and Joëlle Thollot[2]

1. Univ. Paris-Est, LASTIG, IGN, ENSG, F-94160 Saint-Mande, France; firstname.surname@ign.fr
2. Univ. Grenoble Alpes, CNRS, Inria; firstname.surname@inria.fr
3. Polytechnique Montréal, Canada; thomas.hurtut@polymtl.ca

Abstract*:* Mountain maps were the result of hours of precise by-hand drawing reliefs, based on perceptive and cartographic rules. Now, we would like to experiment automated methods in order to generate those very expressive drawings and to make the terrain morphology perceptible. It would also be a way to be able to control possible cartographic styles for mountain map design. A method of automated texture generation has been proposed and extended for cartography in (Loi et al. 2013, Loi, 2015). Iterations between cartographers and researchers in GISciences and Computer graphics allow experimenting and specifying various data and rules in order to influence the texture generation for terrain perception. The method is very promising, in order to be used in existing expressive cartographic pipelines, and can be subtly controlled to generate various types of textures for other expressive cartographic styles.

Keywords: map design, mountain maps, style, topographic maps, textures.

Terrain perception is based on the understanding of its main morphological structures (height, slope, roughness, ridges, valleys, etc.) and is crucial, in particular to determine where the hazardous zones or paths are. The drawing of mountain maps has been made by hand for a long time in National Mapping Agencies, at various representation scales. Mountain maps were the results of hours of precise and attentive manual work, based on the information of main heights and on design rules for relief drawing. Some beautiful maps have been made in the fifties at a 1:10000 scale, based on expressive hatching textures representing rocky area. These maps have been used to extract the main edges for smaller scales, for instance 1:25000 and 1:50000 scales. Until now, certain parts of the terrain, such as rocks and scree, have been represented in traditional topographic map series production line, with the help of scans of those hand drawn rock hatchings. Today, this production line is going to be updated and the use of those scans is a problem for its global automation. Moreover, the delineation of the represented data have changed, for instance relatively to the melting of glaciers. Nevertheless cartographic expertise about the knowledge on the manual rock drawing tends unfortunately to disappear.

In the context of the MapStyle project[1] aiming at exploring expressive topographic styles in map design, we would like to propose a specific automated method dedicated to rocky area depiction, based on the rock drawing style from the map of the Aiguille du Moine, French Alps, 1:10000 scale. As a basic representation rule for rock drawing, the main structures (edges and passes) are never directly drawn, but are visually perceived thanks to the expressive power of the hatching textures, and its particular distributions, densities and orientations according to heights, slopes and illumination. This particular style of rocky area drawing also comes from the own expressive styles of the cartographers.

We share the need and the perspective of specifying mountain topographic styles with previous research works, in particular on the Swiss-style rock drawing (Jenny at al. 2014, amongst others) or the style used in Czech topo-

[1] http://mapstyle.ign.fr

graphic maps (Lysak, 2016). Unlike existing raster-based methods (Geisthövel & Hurni, 2015), a programmable and generic approach to generate vectorial textures has been proposed, offering a proper flexibility in the specification of the targeted style, as well as a lot of control over the hatching arrangement (Loi et al. 2013, Loi 2015). The approach is presented for generic design purposes, and has been extended, based on the influence of external topographic data on hatching arrangements in our specific context of rock drawing at the 1:10000 scale.

We have been experimenting an iterative approach between researchers in computer graphics and in geographical information sciences, in order to adapt the method and to control the possible renderings of hatching textures. In order to make the terrain perceptible and expressive, two particular layers of hatching arrangements are automatically generated by the method:

- a filling layer made of hatching arrangements varying in density, according to faces illumination;
- a ‘ink accumulation effect’ layer made of specific hatching varying in density, lengths and distribution, according to heights and distance to the summits.

Figure 1 presents a comparison between a zoomed extract of the initial map layer of rocky drawing and the automated output of our system based on the two different layers. Here, the geometries are roughly rendered with a basic style (1-pixel wide rendering of the linear geometries in black). The terrain perception is already promising, because it highlights the variation of heights and separation of mountain faces. In the south-west part, multi-faces are also visible, which is also an issue for terrain perception.

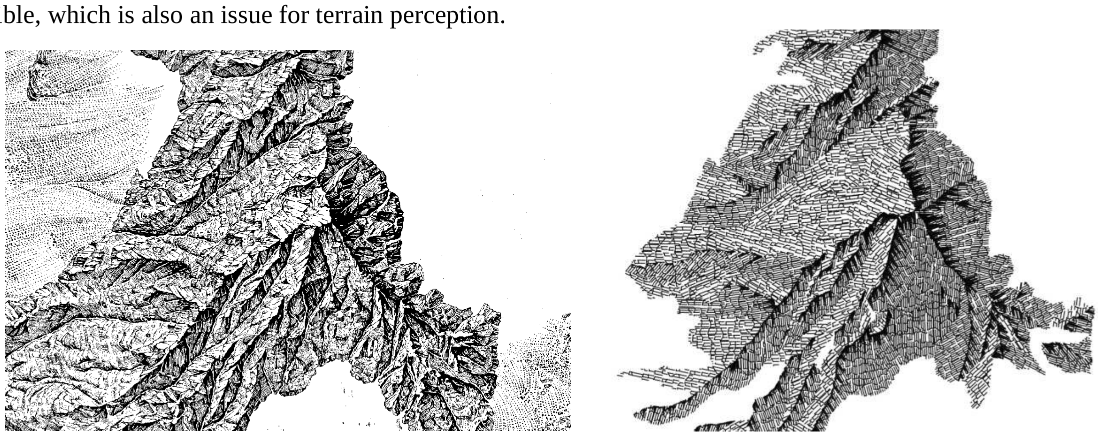

Fig. 1: Zoomed extract of rocky layer of the Aiguille du Moine 1:10000 scale map and related output of hatching arrangements (Christophe et al. 2016, Loi 2015).

Next, a stylization step has been performed on those geometries in order to mimic the original map. Figure 2 presents the results of the compositing of various initial map layers (glaciers, screes, contour lines, toponymy) and our automated stylized rocky layer output, in order to compose a new map of the Aiguille du Moine.

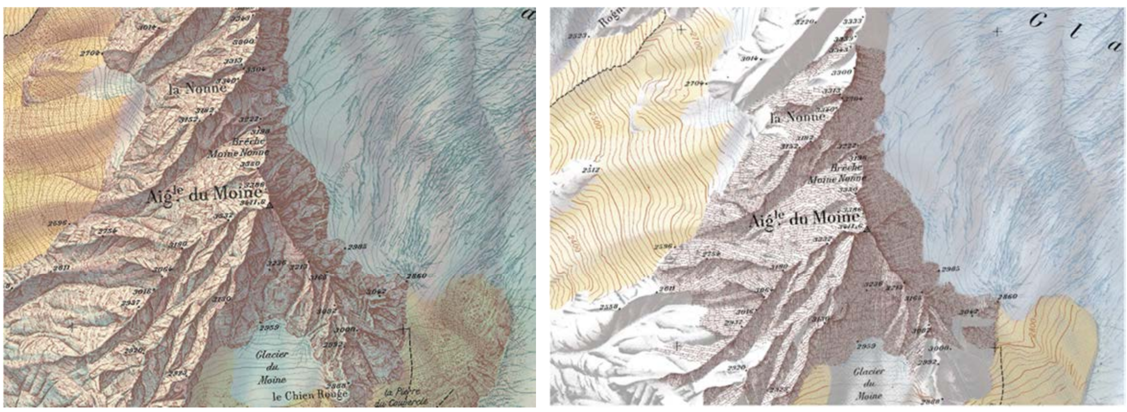

Fig. 2. Zoomed extract of the Aiguille du Moine 1:10000 scale map and its related compositing map with the automated stylized output (Christophe et al. 2016, Loi 2015).

The result, automated geometries and related stylization, is very expressive and subtly render the main characteristics of the morphology of the terrain. Now, we need more precise data in order to experiment the method on the entire map and to test the applicability of the proposed rendering in alternate areas. This method is suitable to generate cartographic data that can then be stylized in our expressive cartographic pipeline (Christophe et al. 2016) in order to render expressive mountain maps.

Acknowledgements

This work was supported by a grant overseen by the French National Research Agency (ANR) as part of the MapStyle project [ANR-12-CORD-0025].

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